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Indian Standard

SPECIFICATION FOR INSET TYPE AERODROME LIGHTING FITTINGS

PART 1 GENERAL REQUIREMENTS AND TESTS

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SPECIFICATION FOR INSET TYPE AERODROME LIGHTING FITTINGS

PART 1 GENERAL REQUIREMENTS AND TESTS

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PART 1 GENERAL REQUIREMENTS AND TESTS

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Indian Standards Institution on 5 October 1984, after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Aerodrome lighting fittings find applications in both civil and military aerodromes for giving lighting guidance to aircrafts during dark periods and under poor visibility conditions. Though the applications and the lighting requirements are not quite the same for both civil and military aerodromes, need has been felt to coordinate requirements of both and bring out specifications for such fittings.

0.3 This standard is one of the series of Indian Standards which deals with inset type of aerodrome lighting fittings. This series consists of the following parts:

Part 1 General requirements and tests

Part 2 Runway centre line lighting fittings

Part 3 Approach lighting fittings

Part 4 Touchdown zone lighting fittings

0.4 This standard provides in general a set of requirements and tests which are considered to be essential for these types of fittings. Subsequent parts of this standard deal with different types of fittings and also include additional requirements as necessary for particular type of fittings.

0.5 In preparing this standard, assistance has been derived from the following:

International standards and recommended practices — Aerodromes Annex 14 (1976). Ed 7. International Civil Aviation Organization.

Aerodrome design manual; Part 4 Visual aids. Ed 1. 1976. International Civil Aviation Organization.

Advisory circular No. 150/5345-46 (1975) Specification for semi-flush airport lights. Department of Transportation, Federal Aviation Administration, USA.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part 1) covers the general requirements and tests for the inset type aerodrome lighting fittings for various applications.

2. TERMINOLOGY

2.1 For the purpose of this standard, the following definition in addition to those given in IS : 1885 (Part 16/Sec 1)-1968†, IS : 1885 (Part 16/ Sec 2)-1968‡ shall apply.

2.2 Inset Lighting Fitting — Light fittings inset in the surface of runways, stopways, taxi-ways, aprons, etc, so as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.

3. CONDITIONS OF USE

3.1 The fitting shall be suitable for use on ac or dc systems, with a voltage not greater than 50 V dc or ac (rms) to earth.

3.2 Environmental Requirements — The equipment shall be designed for outdoor installation and continuous operation, and shall meet all specified requirements while operating under the following environmental conditions.

3.2.1 *Temperature* — A temperature range from −20°C to +55°C.

3.2.2 *Altitude* — Any altitude from sea level to 3 050 m above sea level.

*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary : Part 16 Lighting, Section 1 General aspects.

‡Electrotechnical vocabulary : Part 16 Lighting, Section 2 General illumination, lighting fittings and lighting for traffic and signalling.

3.2.3 *Humidity* — A humidity range from 10 percent to 100 percent at +55°C ambient temperature.

3.2.4 *Sand and Dust* — Exposure to airborne sand particles encountered on deserts or the result of jet blast from aircraft.

3.2.5 *Salt Spray* — Exposure to a salt-laden atmosphere.

3.2.6 *Thermal Shock* — The fitting shall be able to withstand the thermal shock likely to be encountered by sudden cooling and heating.

3.2.7 *Vibration and Impact Strokes* — The fittings shall be able to withstand the vibration and impact strokes encountered due to the movement of aircraft on the running.

3.3 The fitting shall be capable of withstanding the impact loads under the actual operating conditions, namely, standstill, rollout landing, etc.

3.4 Care shall be taken in the design of the fitting to avoid the use of surfaces or components on which snow, ice, water, dust or blast effects from the jets can collect, which may effect the light beam adversely.

4. GENERAL CONSTRUCTION

4.1 The lighting fittings shall consist essentially of an optical system, a lamp or lamps, socket or sockets (lamp holder or holders) mounted in a suitable base receptacle connecting leads, and a mounting assembly for installing the unit securely in place.

4.2 The lighting fittings should comprise of a top light assembly and a base receptacle. All interfaces of the top assembly and base receptacle shall be machined to the same true finish. Pry bar slots, indentation or other suitable means shall be provided for prying or jacking the top assembly free of the base receptable. The base receptable shall be capable of installation in a drilled cavity in the concrete/asphalt runway pavement. The depth of the cavity shall be decided as per the mutual agreement between the purchaser and the supplier.

4.3 The assembled light fitting shall not project above the surrounding pavement by more than the limits specified for the fittings in the individual parts of this standard. The external portions of the top assembly which extends above the pavement shall be smoothly sloped upwards from the edges.

4.4 Lamp and Lamp Holder

4.4.1 The lamp used in top assembly shall be of quartz halogen type with a rated average life at full brilliancy of not less than 500 hours.

The lamp shall be capable of easy replacement in the field with the help of standard tools. Preferred ratings of lamps shall be 6·6 and 20A.

4.4.2 The lamp holder shall securely and accurately position the lamp in the fitting. Relamping, when done shall not distrub colour filters or other optical components and after relamping there shall be no change in the photometrics.

4.4.3 *Lamp by-Pass and Holder* — At the option of the purchaser an electrical by-pass device, which immediately closes an auxiliary circuit around the lamp on failure of the lamp, shall be available for each light assembly. A film disc cutout or other suitable device may be used for this function. A suitable holder shall be furnished for mounting this device. Necessary wires or current-carrying members shall be installed to provide a path for the current to flow through the by-pass device when the filament opens.

5. OPERATING TEMPERATURE

5.1 With the unit operating at continuous full brilliancy and under maximum ambient conditions of temperature, no parts of the complete assembly shall deteriorate or get damaged on account of thermal stresses applied under rain or snow conditions.

5.2 When the unit is operating at a continued full brilliancy, it shall dissipate the heat generated within, in such a manner that no component of the hard-ware develops temperature exceeding the limits specified in the relevant clauses.

6. OPTICAL COMPONENTS

6.1 The prisms shall be made of heat resistant glass designed to withstand the heat build up and also the thermal stresses on account of external rain or snow. The prisms shall be accessible for easy maintenance and periodical cleaning. The windows in front of the prisms should not have appreciable negative slopes which would result in accumulation of dirt, water, etc, and contribute towards deterioration in photometric performance.

6.2 All reflectors used in the optical assembly shall have high specular reflectivity and shall be protected from dirt and tarnishing.

6.3 The optical system shall have provision for addition of filters of heat resistant material wherever required. The chromaticity and other colour requirements of these filters shall conform to the requirement specified in IS : 7785 (Part 1)-1975*. Such additional filters should not

*Specification for elevated type aerodrome lighting fittings: Part 1 General requirements.

require use of special tools and shall be arranged in such a way that there is no leakage of white light after fixing of the filters.

6.4 All components including optical top head and base receptacle shall be corrosion resistant and shall not be effected by continued atmospheric action. Dissimilar materials in contact with each other which will lead to bi-metallic corrosive action shall not be used. All parts/components not made up of stainless steel shall be rendered resistant to corrosion by plating, anodizing or painting.

6.5 Prisms, gaskets and other parts of the units shall not be damaged by water hammer action encountered during aircraft movement over the fittings.

6.6 The base receptacle should have external ribs or other locking device feature so as to minimise vertical, lateral and rotational movements of the base receptacle from the installed position in the pavement.

6.7 The base receptacle shall be so constructed that it permits addition of adaptor rings (life rings) to take care of future increments on the pavements surface.

6.8 The top assembly unit shall have a portion extending into the base receptacle so as to restrict side motion and shear action when the unit is struck.

7. ALIGNMENT DEVICES

7.1 Each consignment of lighting fittings shall be supplied with the alignment devices suitable for installating the inset lighting fittings in the pavement.

NOTE — Number of alignment devices in each consignment of lighting fittings should be mutually agreed to by the purchaser and the manufacturer at the time of placing the order.

8. WATER TIGHTNESS OF THE UNIT

8.1 The complete assembly shall be waterproof and shall remain so under all normal operating conditions. It shall also meet the requirements as detailed in **11.10** for water leakage test.

8.2 Wherever gaskets are used, they should be of 'O' ring type properly seated in their grooves. Such 'O' ring gaskets shall be moulded from the best quality silicone/neoprene rubber. Such gaskets shall be suitable of performing satisfactorily for a period of at least one year of operation which would include at least 15 top assembly removals and replacements.

Under no circumstances bitumenuous or other similar sealing compounds shall be used on such joints.

8.3 All hold-down bolts, nuts and washers shall be made of the best quality stainless steel.

8.4 Hold-down bolts shall be hexagonal head type. There should be clearance for application of socket/torque wrenches. Such bolt heads shall not project above the surface.

8.5 There shall be adequate clearance under the hold-down bolts to serve as a sump for foreign matters. This would enable the hold-down bolts to be properly tightened to the required torque value under normal field operation conditions. The cementing of prisms in the top optical head shall be such as to render the top unit completely water tight under normal operating conditions. Power leads to the optical system shall be brought through the base receptacle. The wire entry arrangement shall be completely water proof under all operating conditions.

9. ELECTRICAL COMPONENTS

9.1 All electrical components used in the fittings shall be rated for at least 500 V (rms value to ground) and shall have a current carrying capacity of at least 1·5 times the rated current.

High conductivity, non-corrosive metal suitably protected against corrosion shall be used for current carrying components. Aluminium will not be acceptable for the purpose.

9.2 Leads — Leads furnished with lighting fittings shall have stranded copper conductor with insulation rating of at least 500 V and thermal rating to withstand the maximum operating temperatures of 250°C encountered in the fittings. The leads shall have sufficient spare length inside the base receptacle to permit servicing of the optical assembly without disconnection. The exterior leads shall be at least 45 cm in length. The wire entry shall be factory sealed to ensure a water tight and air tight arrangement.

10. MARKING

10.1 The fittings shall be clearly and indelibly marked externally with the following:

a) Manufacturer's name or identification mark,

b) Type or reference number, and

c) Lamp identification reference (this may be internal).

10.1.1 Detachable parts shall be permanently and indelibly marked with identification markings.

10.2 The fittings may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

11. TESTS

11.1 Classification of Test

11.1.1 *Type Tests* — The following shall constitute the type tests:

a) Visual examination (*see* **11.2**),

b) Photometric test (*see* **11.3**),

c) Insulation resistance test (*see* **11.4**),

d) Vibration test (*see* **11.5**),

e) Cycling and thermal shock test (*see* **11.6**),

f) Low temperature test (*see* **11.7**),

g) Accelerated life test (*see* **11.8**),

h) Static load test (*see* **11.9**),

j) Leakage test (*see* **11.10**),

k) Impact test (*see* **11.11**),

m) Horizontal static load test (*see* **11.12**),

n) Hydraulic impact test (*see* **11.13**),

p) Protective plating test (*see* **11.14**),

q) Lamp by-pass test (*see* **11.15**),

r) Surface temperature test (*see* **11.16**),

s) Humidity test (*see* **11.17**),

t) Salt spray test (*see* **11.18**),

u) Rain test (*see* **11.19**), and

v) Dust test (*see* **11.20**).

11.1.2 *Acceptance Test* — The following shall constitute the acceptance tests:

a) Visual examination (*see* **11.2**),

b) Photometric test (*see* **11.3**),

c) Insulation resistance test (*see* **11.4**),

d) Vibration test (*see* **11.5**),

e) Cycling and thermal shock test (*see* **11.6**),

f) Static load test (*see* **11.9**),

g) Leakage test (*see* **11.10**),

h) Impact test (*see* **11.11**), and

j) Horizontal static load test (*see* **11.12**).

11.1.3 *Routine Test* — The following shall constitute the routine tests:

a) Visual examination (*see* **11.2**),

b) Photometric test (*see* **11.3.3**),

c) Insulation resistance test (*see* **11.4.3**), and

d) Leakage resistance test (*see* **11.10.2**).

11.2 Visual Examination — Lighting fittings shall not have any visible sign of damage. Compliance is checked by visual examination.

11.3 Photometric Test

11.3.1 The optical parameters of the lighting fittings shall be determined by photometric measurements with a clear lens and with the type of lamp and optical system for which the unit is designed. The lamp shall be operated on its rated current for a period of at least 15 minutes before photometric measurements are made. The photometric axis of the fitting shall be established in relation to a fitting properly installed in the pavement with the horizontal axis lying on the plane of the pavement, passing through the centre of the fitting and parallel to the central line of the runway. The vertical axis shall lie on a line passing through the centre of the fitting and perpendicular to the runway pavement plane.

11.3.2 Vertical and horizontal intensities shall be determined at one degree interval and should not be less than the value indicated in the respective individual parts of the fittings.

11.3.3 For the purpose of routine photometric test the intensity shall be reversed at the following points:

a) At horizontal angles of $\pm 5°$ from centre line axis in a plane with an elevation angle of 6°, and

b) At 12° vertical and 0° horizontal. The values obtained shall correspond to those specified in the respective individual parts for the fittings.

11.4 Insulation Resistance Test

11.4.1 The assembled lighting fitting shall be operated at rated current at room temperature until the voltage across the pig tail leads has reached a stable value for at least 10 minutes. The established value of voltage shall be measured and recorded. The lighting fitting, except for the ends of the leads, shall then be completely submerged in bath containing saturated salt solution and operated at rated current continuously. The salt water bath shall be adequately earthed and its temperature maintained at 15 to 25°C by occasional stirring. Current through the pig tail leads shall be maintained at rated current during this immersion. After 3 hours of operation in the saturated salt solution bath, the voltage across the pig tail leads shall be adjusted to and maintained at the earlier recorded value. Current readings shall then be taken in the following conditions:

a) With one pig tail lead earthed,

b) With earth removed from the first tail and other pig tail lead earthed, and

c) With neither of the pig tail leads earthed.

If any of the three current readings exceeds 1·5 percent of the rated current, the light fitting shall be rejected.

11.4.2 After the test described in **11.4.1** the lighting fitting shall be subjected to an insulation resistance test with a 500 V insulation megger and the value should not be less than 100 megohms.

11.4.3 For the purpose of routine insulation resistance test the fitting shall not be subjected to the test described in **11.4.1**. For routine test the fittings shall be subjected to a insulation resistance test with a 500 V insulation megger and the value shall not be less than 100 megohms.

11.5 Vibration Test

11.5.1 The receptacle shall be securely bolted in place on the surface of the test table of vibration testing machine. It shall be mounted in a horizontal position corresponding to its actual installation in place on the runway. Small angles or brackets may be welded to the base receptacle to hold it in place of the test table. The top assembly with an electrical short circuit across the lamp terminals and with the lamp in place, shall be installed in the receptacle with provisions to determine whether continuity of the electrical circuit is maintained during the test.

11.5.2 The light assembly mounted in place on the test table as described above, shall be vibrated in 3 planes as follows:

a) Vibrated vertically in a direction perpendicular to the plane of the test table,

b) Vibrated horizontally in a direction parallel to the light axis, and

c) Vibrated horizontally in a direction at right angles to the light axis.

11.5.3 The light fitting shall be vibrated in each plane through a frequency range of 10 Hz to 2 000 Hz until the '*g*' values shown in the Table 1 are reached. The duration of each sweep on the light assembly shall be 10 minutes and electrical continuity shall be continuously monitored during the test. After completion of the test, the loosening of any components/screws or any discernible movement of the lamp in the lamp holder shall be cause for rejection.

TABLE 1 VIBRATION FREQUENCIES

ACCELERATION *g*	FREQUENCY Hz
10	10 to 500
15	500 to 2 000

11.6 Cycling and Thermal Shock Tests — The fitting complete with its base receptacle shall be subjected to a full load operation at the rated current at room temperature for a period of at least 4 hours. At the end of this 'ON' part of the cycle, the fitting shall be de-energized and immediately submerged at least 30 cm in water. The temperature of water before submersion shall be 5°C or lower. The fitting shall remain under water for at least 4 hours. After the expiry of 'OFF' part of the cycle,

the fitting shall be subjected to repetition of the above test until a total of 3 'ON-OFF' cycles have been completed. Immediately after the completion of the cycles, the fitting would be inspected thoroughly. Any evidence of glass breakage or lens damage, traces or leakage of water into the assembly, damage to any part of the unit or equipment failure during this test shall be a cause for rejection.

11.7 Low Temperature Test — The lighting fitting assembled, complete with its base receptacle, shall be totally immersed in water and while immersed subjected to a low temperature of $-20 \pm 2°C$ for a period of 24 hours followed immediately by operation at rated current for 30 minutes or until free of ice. This test shall be repeated for 3 cycles. Any evidence of damage shall be a cause for rejection.

11.8 Accelerated Life Test — The fitting shall be subjected to accelerated life test after it has successfully passed the above tests. The fitting assembly mounted on the base receptacle shall be set in dry sand in an ambient temperature $55 \pm 2°C$ simulating its installation in pavement. The sand shall be at least 12·5 cm thick around the sides and bottom of the light unit and shall also fill in openings in the light assembly which are below the pavement level. The fitting shall then be operated for at least one half of the rated lamp life at the full rated current. The light units equipped with colour filters should have filters in place during this test. During this test, the temperature rise on the top surface of the optical head shall not exceed 160°C. On completion of this test, the photometric performance of the unit shall be measured as described in **11.3.1**. Intensities shall not be less than 80 percent of the values initially measured. After this test, the light assembly shall be taken apart and thoroughly examined. Any visible deformation, blistering, evidence of heat damage or corrosion shall be a cause for rejection.

11.9 Static Load Test — The assembly shall be placed on a flat steel plate mounted in a standard test machine. The load shall be applied to the top part of the fitting through a block of rubber with a thickness of 40 mm, having a shore 'A' hardness of 55 to 70. The load shall be applied uniformly, and increased at the rate of 6·5 kg/cm^2 per minute and at this rate a total load of 65 kg/cm^2 shall be applied. The lighting fitting shall be considered unsatisfactory, if there is any permanent deformation, cracking of material or finish, breaking or damage to any part of the fitting.

11.10 Leakage Test

11.10.1 This test shall be performed after the lighting fitting has successfully undergone the static load test as described in **11.9.1**. For this test, the top assembly shall be securely bolted to the base receptacle with

bolts torqued down to manufacturer's specifications and suitable means provided for pressurising the inside. Prior to performing this test, the lead wires shall be subjected to 15 kg tension for 5 minutes. With a minimum internal pressure of 1·5 kg/cm^2, the assembled unit shall be tested against leakage using bubble test material or by immersion in water. The fitting shall be considered water tight if no air bubbles appear.

11.10.2 For the purpose of routine test the test shall be carried out by means of a standard head and a standard base properly fitted with pressure fittings to permit each top assembly and base receptacle to be subjected to a pressure of at least 1·5 kg/cm^2.

11.11 Impact Test — The assembled unit shall be mounted rigidly on either a 25 mm thick steel plate or a concrete base at least 100 mm thick. The dimensions of the steel plate or the concrete base shall be at least 1 M. The lighting fitting shall be turned on at full brightness for at least 2 hours prior to starting this test. With the light still on at full brightness, a steel ball weighing 2·25 kg shall be dropped at the centre of the top assembly from a height of 1·8 metres. The steel ball shall be dropped ten times on the lighting fitting with a 5 minute interval between each drop. On completion of this test, the lighting fitting shall be dismantled; any damage to the optical assembly or displacement of any component, shall be a cause for rejection.

11.12 Horizontal Static Load Test — The light unit shall be placed in a hydraulic press with a bar attached to the top surface. A load of 1 400 kg shall be applied parallel to the light beam. This test shall be repeated 20 times in each direction. There shall be no sign of structural damage, movement of any part or loosening of components/fasteners.

11.13 Hydraulic Impact Test — The light fitting shall be submerged in water to a depth of approximately 1·27 cm. The upper surfaces of the light assembly around the windows shall be fencased in a leak proof metal housing with a 4·54 cm diameter piston. The chamber shall be filled with water and purged of all air. A 2·27 kg steel ball shall be dropped 1·73 metres onto the steel cylinder. The lighting fitting shall show no visible damage after the above test has been repeated five times.

11.14 Protective Plating Test — Zinc and cadmium plating shall be tested as per the relevant Indian Standard (*see* IS : 1572-1968*, IS : 1573-1970†, IS : 6745-1972‡, etc).

*Electroplated coatings of cadmium on iron and steel (*first revision*).

†Electroplated coatings of zinc on iron and steel (*first revision*).

‡Methods for determination of weight of zinc coating on zinc coated iron and steel articles.

11.15 Lamp By-pass Test — The lighting fitting shall be subjected to a test as described below to determine if the lamp by-pass device (incorporated in the fitting) will immediately close an auxiliary circuit around the lamp when its filament opens. The test shall be done by either of the test method given in **11.5.1** and **11.5.2.**

11.15.1 Lamp by-pass equipment shall be tested to demonstrate the ability to operate at 6·6, 5·2, 4·1, 3·4 and 2·8 amperes within 5 seconds. The source of energy for testing the bypass device shall be the output of an isolation transformer; the size (rating) of the transformer shall be that which is normally used with the lamp.

11.15.2 The fittings shall be assembled to simulate actual operating procedures and connected across the secondary of a 200 watt transformer. The primary of the 200 watt transformer shall be connected to a constant current supply. An open lamp filament shall be simulated under the following conditions:

With 6·6 amperes flowing through the primary of the transformer for a minimum of 3 hours, disconnect a lamp in one fitting. The by-pass device shall operate within a 5-second period. Without de-energizing the circuit, reduce the current to 4·8 amperes and disconnect a lamp in one of the remaining fittings. The by-pass device shall operate within a 5-second period. With the circuit de-emergized, restore the circuit to its original state of readiness, disconnect the lamp in one fitting, set constant current supply for 4·8 amperes output level, and then energize the circuit. The by-pass device shall operate within a 5-second period. Repeat the above procedure with the constant current supply set for 6·6 ampere.

11.16 Surface Temperature Test — Tests shall be conducted with each type of light unit to assure that maximum temperature on top of the inset light will not exceed 160°C when the light is covered with the tire of a heavy ground vehicle for a period of 10 minutes. The light unit shall be operated at high insensity for at least 2 hours, before this 10-minute test period, in still air whose ambient temperature is 25°C. The thermocouple shall be located between the hottest point of the lamphead and the tire to register the test temperature.

11.17 Humidity Test — The lighting fitting shall withstand a humidity test conducted in accordance with IS : 9000(Part 4)-1979*. Any evidence of damage, resting, or corrosion shall be cause for rejection.

NOTE — The duration for carrying out the test shall be mutually agreed to between the purchaser and the supplier.

*Basic environmental testing procedures for electronic and electrical items: Part 4 Damp heat (steady state).

11.18 Salt Mist Test — The lighting fitting shall withstand a salt mist test conducted in accordance with IS : 9000 (Part 11)-1983*.

11.19 Driving Rain Test — The lighting fitting shall withstand a driving rain test conducted in accordance with IS : 9000 (Part 16)-1983†.

11.20 Dust Test — The lighting fitting shall withstand a dust test conducted in accordance with IS : 9000 (Part 12)-1981‡.

*Basic environmental testing procedures for electronic and electrical items: Part 11 Salt mist test.

†Basic environmental testing procedures for electronic and electrical items: Part 16 Driving rain test.

‡Basic environmental testing procedures for electronic and electrical items: Part 12 Dust test.